

Remarks

Summary of the Office Action

Claims 1-12 were pending.

Claims 1-6 have been rejected under 35 U.S.C. § 102(b) as being anticipated by either of Entrekin et al. U.S. patent No. 4,838,340 ("Entrekin"), Harker U.S. patent No. 4,932,635 ("Harker I") or Harker et al. U.S. patent No. 4,961,776 ("Harker II"). Claims 6-12 have been rejected under 35 U.S.C. § 103(a) as being obvious from Entrekin. Further, claims 2-6 have been objected to under 37 C.F.R. 1.75 as double patenting.

Applicants' Reply

Applicants respectfully traverse the prior art rejections and the 37 C.F.R §1.75 objections.

37 C.F.R §1.75 objections

Applicants have amended claims 2-6 to clarify the invention and to address the 37 C.F.R §1.75 objections. In particular, each of the dependent claims 2-6 now calls for a specific and different numbered (i.e., first, second, etc.) set of program instructions. Applicants respectfully submit that amended claims 2-6 properly limit the apparatus of claim. Further, claims 1-6 have distinctly patentable subject matter and conform to all requirements of 37 C.F.R §1.75.

Prior art rejections

Applicants have improved upon prior art cold hearth refining apparatus and processes. Claims 1-12 are directed to the improved cold hearth refining apparatus. Claim 7 -12 are directed to the improved cold hearth refining apparatus and methods.

Independent Claim 1

Applicants' cold hearth refining apparatus includes two conventional elements — (a) a cold hearth which holds a pool of molten material, and (b) a select first electron gun of a first type. The position and the structural/operational characteristics of this electron gun are selected so that electron beams generated by this electron gun have sufficient power and direction to keep the material in the pool in its molten state.

The “improved” apparatus, according to claim 1, further includes new element (c): “means to inhibit formation of skull wings at the edges of the pool of molten metal formed by the electron beam generated by the first electron gun.”

Applicants respectfully submit that this last feature of claim 1 is not shown, taught or suggested by the cited prior art references — Entrekin, Harker I and Harker II. In particular, the cited references do not show, teach or suggest the particular “means” element recited in claim 1.

Applicants incorporate by reference the previous Replies which addressed the features of Entrekin, Harker I and Harker II (which are or were commonly owned by the assignee of the present application) with reference to applicants' claims.

Applicants again note that the cited references describe now conventional aspartates and methods for cold heart refining. The apparatus and methods described in Entrekin, Harker I and Harker II are directed to the formation of the molten pool of material by the now conventional “first electron gun”. As previously noted the cited references do not address the problem of the formation of skull wings at the edges of the pool of molten metal formed by the electron beam generated by the first electron gun. The present invention addresses this problem by providing additional means to inhibit the

formation of skull wings at the edges of the pool of molten metal formed by the electron beam generated by the first electron gun.

As noted in the previous Reply, Entrekin describes continuous casting of fine grain ingots. Entrekin deploys conventional electron beam configurations to heat “a central portion” and “raise the temperature” of the molten liquid metal. (See e.g., FIGS 1 and 2, col. 4 lines 26-52, claim 2, etc.). The portion of Entrekin (i.e., col. 4 lines 27-35) cited by the Examiner (see Office Action, page 3 top) relates to conventional “bulk melting” operation, and not to any “evaporating impurities that are collected on the pool edge”. (See col. 4 lines 27-36 “the directed energy input devices are controlled . . . to make certain that the [bulk] molten material contains no solid particles . . . [And] to raise the temperature of the [bulk] material in the pool”).

Again as noted in the previous Reply, Harper I and II both describe directed energy input devices 15 designed to form or reheat molten pools of [Bulk] liquid metal. (See e.g., Harper I, FIG. 1, col. 2 lines 47-63: “energy beams 15 directed to desired regions of the hearth to heat material 14 to be melted,” “one of electron beams 16 is concentrated on raw material 14 in a melting region 17 . . . so as to melt that material,” etc.). The portions of Harker I and II (i.e., col. 2 lines 45-61) cited by the Examiner (see Office Action, page 3 middle) relates to conventional “bulk melting” operation, and not to “evaporating impurities that are collected on the pool edge.. Applicants note that the “desired manner” which is mentioned at col. 5 line 53 for controlling the electron beam, does not refer to “any” arbitrary desirable manner, but specifically refers to the desired regions to heat the [bulk] material 14 to be melted (see preceding lines 50-53).

Applicants also note that the Harker patents, which clearly describe the formation of solid

“skulls” to confine the pool of [bulk] molten material, do not address the issue of skull wing formation and inhibition.

Applicants emphasize that the cited references relate to melting of the raw material, but not to the evaporation or inhibition of skull material or skull deposits. (See e.g., Harper I, col. 2 lines 47-63 “energy beams 15 directed to desired regions of the hearth to heat [raw] material 14”. Thus, the cited references do not show the particular “means to inhibit formation of skull wings at the edges of the pool of molten metal formed by the electron beam generated by the first electron gun,” (which is further described in claim 2-6).

Applicants’ respectfully disagree with Examiner’s reading of applicants’ claims as only referring to the manner in which an electron gun is used. (See e.g. Office Action page 3 ¶¶1-2). In deed, applicants’ claims call out for two distinct structures - a first electron gun of a first type and a “means . . . inhibiting skull deposits.” Applicants’ respectfully submit that person of ordinary skill in the art will readily recognize that a “bulk melting” electron gun is structurally different from an electron gun used, for example, for evaporating or inhibiting deposits.

In particular, applicants specifically call out for a first electron gun having suitable power specifications for melting raw material which is structurally different than the claim 1: “means to inhibit formation of skull wings at the edges of the pool of molten metal formed by the electron beam generated by the first electron gun.” Similarly, the first electron gun having suitable power specifications for melting raw material is structurally different than the claim 2: “means [comprising] a programmable device coupled to a second electron gun of a second type that is disposed at geometric position

relative to the cold hearth and having power specifications namely voltage, current and pulse rate specifications different than those for the first electron gun of the first type” Further, the programmable device has a distinct first set of program instructions, which is structural difference and not merely a difference in the manner of use.

Applicants respectfully submit that for at least the foregoing reasons claim 1 is patentable over the cited references.

Independent claim 7

Claim 7 is directed to a method for cleaning a perimeter of a pool of molten material formed by a first electron beam generated by an electron gun of a first type in a cold hearth melting and refining arrangement.

The elements of claim 7 include:

“utilizing an electron gun of a second type to generate ~~an~~ a second electron beam; and

using a programmable device to automatically sweep a portion of the perimeter of the liquid pool with the second electron beam so that volatile impurities that evaporate from the pool of molten material formed by the first electron beam generated by the electron gun of the first type and recondense on the perimeter of the pool of molten material are dispersed.

As discussed above with reference to claim 1, the cited references describe only heating of material (e.g., central portions) to form or reheat [bulk] pools of molten material. None of the cited references describe or suggest perimeter cleaning using an electron beam. In particular, Entrekin does not show, teach or suggest “sweep[ing] the second electron beam so that volatile impurities that evaporate from the pool of molten

material formed by the first electron beam generated by the electron gun of the first type and recondense on the perimeter of the pool of molten material are dispersed.”

Applicants respectfully submit that the Office Action (page 4) mistakenly concludes that Entrekin col. 4 lines 28-35 relates to or provides motivation for inhibiting skull wing deposits. Entrekin col. 4 lines 28-35 only describes energy input devices 14 and 15 that are directed to “full” melting of the raw material 24 in particular regions of the hearths (e.g., in pool 21). The “vaporization” mentioned by Entrekin line 35 relates to vaporization only of “undesired constituents” and solid particles” in the molten material 24 in pool 21, but not to any control of the skull wings or skull deposits or any other deposits outside the hearth regions to which energy input devices 14 and 15 are directed. (See e.g., Entrekin col. 4 lines 27-40 and also lines 53-60).

Applicants respectfully submit that Entrekin neither provides motivation nor suggests applicants’ claim 7 elements. A person of skill in the art would not find claim 7 to be obvious from Entrekin. Accordingly, claim 7 is patentable over the Entrekin.

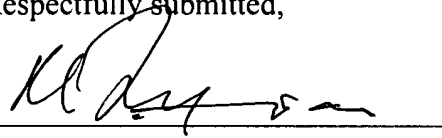
Dependent claims 2-6 and 8-12

Dependent claims 2-6 and 8-12 are patentable over the cited prior art for at least the same reasons that their respective parent claims 1 and 7 are patentable as discussed above.

Conclusion

Applicants respectfully submit that this application is now in condition for allowance. Reconsideration and prompt allowance of which are requested. If there are any remaining issues to be resolved, the applicants request that the Examiner contact the undersigned attorney for a telephone interview.

Respectfully submitted,

A handwritten signature in black ink, appearing to read 'Manu J Tejawani', is written over a horizontal line.

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